

## Three new Malagasy species of *Xyrodromeus* (Ephemeroptera: Baetidae) with the first generic description of the adults

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**Three new Malagasy species of *Xyrodromeus* (Ephemeroptera: Baetidae) with the first generic description of the adults.** - The genus *Xyrodromeus* Lugo-Ortiz & McCafferty includes Afrotropical species of Baetidae (Ephemeroptera) with bladelike mandibles. Three new species of *Xyrodromeus*, *X. modestus*, *X. latipalpus* and *X. sartorii*, are described from the larval stage and the male imago of *Xyrodromeus namarona* Lugo-Ortiz & McCafferty is described from reared material. The knowledge of the imaginal stage greatly clarifies the systematic position of the genus *Xyrodromeus*. A key to larvae of the Malagasy species of *Xyrodromeus* is included.

**Key-words:** Ephemeroptera - Baetidae - *Xyrodromeus* - new species - Madagascar.

## INTRODUCTION

The genus *Xyrodromeus* Lugo-Ortiz & McCafferty was established for two species presenting highly modified mandibles with bladelike incisors (Lugo-Ortiz & McCafferty, 1997). The type-species *X. africanus* Lugo-Ortiz & McCafferty was described from Kenya (East Africa) and *X. namarona* Lugo-Ortiz & McCafferty from Madagascar. The mouthparts of *Xyrodromeus* are highly specialized for scraping stones. Similar adaptations can be found in different baetid lineages in Madagascar, such as *Rheoptilum* Gattolliat (Gattolliat, 2001a), *Dabulamanzia* Lugo-Ortiz & McCafferty (Gattolliat & Sartori, 2000) and *Cloeodes* Traver (Gattolliat, 2001b). Based only on the larval stage, the interpretation of the phylogenetic position of *Xyrodromeus* was unclear, and Lugo-Ortiz & McCafferty (1997) suggested different hypothetical relationships. Based on the absence of a villopore and the structure of the mandible, they concluded that *Xyrodromeus* did not belong to the *Baetis* complex as defined by Waltz & McCafferty (1987c). The *Cloeodes* complex was also eliminated because of the absence of a subproximal arc of setae on the tibiae (Waltz & McCafferty, 1987a, b; Lugo-Ortiz & McCafferty, 1998b; Gattolliat, 2001b). Lugo-Ortiz & McCafferty (1997) indicated a possible relationship with the *Bugilliesia* complex of Africa defined by Lugo-Ortiz & McCafferty (1996) or with Oriental or

Australian taxa, and also noted the similarity of the labrum of *Xyrodromeus* and *Dicentrophtilum* Wuillot & Gillies.

I describe herein three new species from Madagascar and also the male imago of *Xyrodromeus namarona*. The knowledge of the imaginal stage of *Xyrodromeus* provides additional characters that clarify the systematic position of this genus.

The holotypes and part of the paratypes are housed in the Museum of Zoology, Lausanne, Switzerland. Other paratypes are deposited in the Museum National d'Histoire Naturelle, Paris.

## TAXONOMY

### *Xyrodromeus modestus* sp. n.

Figs 1-13

#### MATERIAL

Holotype: 1 larva (P0893), Madagascar, Ampary bas., Anlanbe riv., Loc. Anjanaharibe Sud-Ouest Camp1, Long. 49°26'53" E, Lat. 14°47'00" S, Alt. 1200 m, 26.10.1999. Doumenq E.

Paratypes: 1 female larva 893a (on slide), 1 male larva 893b (on slide) and 10 larvae (P0893), same data as holotype. 14 larvae (P0897), same locality as holotype, 27.10.1999. Doumenq E. 1 larva, P1009, Madagascar, Lokoho bas., Manantenina riv., Loc. Marojejy Camp2, Long. 49°45'58" E, Lat. 14°26'23" S, Alt. 800 m, 26.11.1999. Doumenq E. 14 larvae (P1021), Madagascar, Lokoho bas., Marolakana riv., Loc. Anjanaharibe-Sud Camp 3, Long. 49°26'50" E, Lat. 14°44'50" S, Alt. 1550 m, 08.12.1999. Doumenq E.

#### LARVA

*Maximum length:* Body 5.7 mm. Cerci 6.3 mm and terminal filament 2.8 mm.

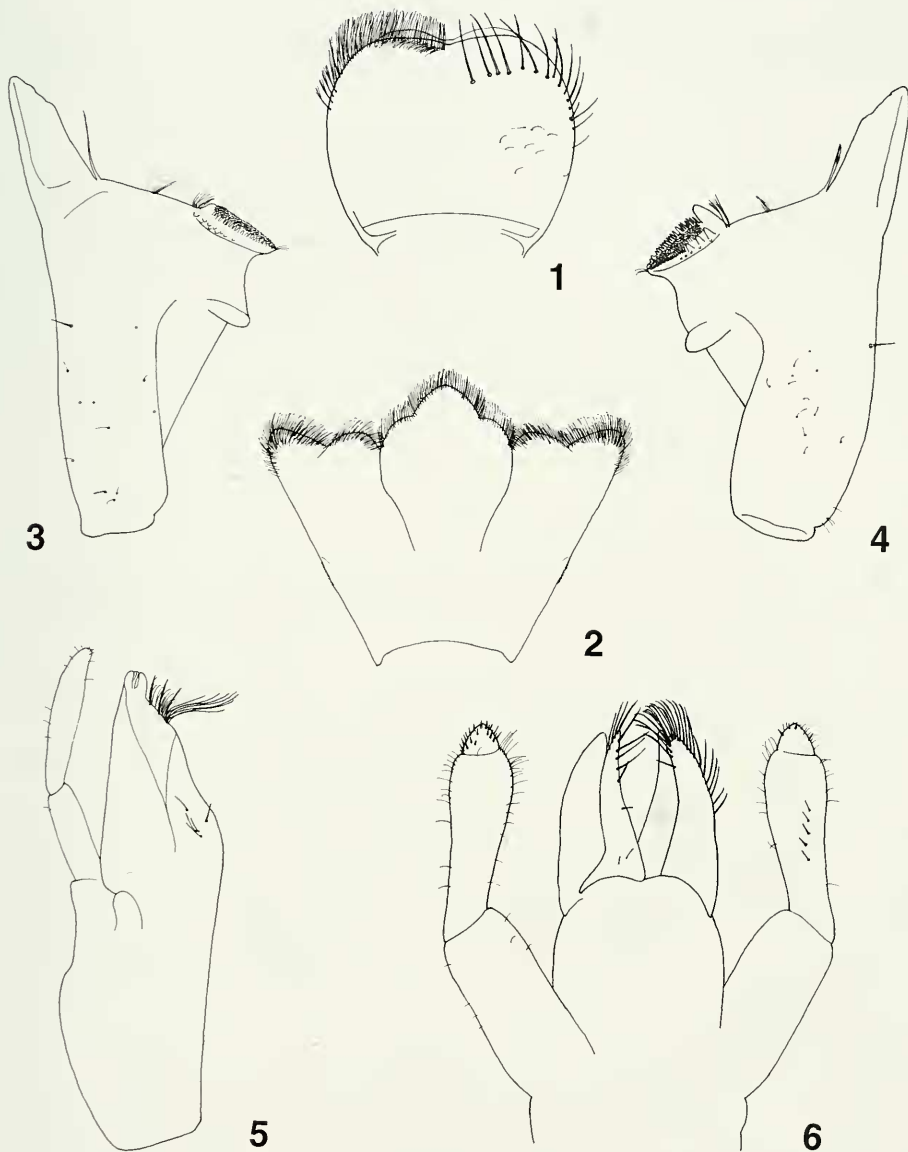
*Head.* Coloration almost uniformly light brown with vermiform marks on vertex and frons. Antennae light brown. Turbinate eyes light brown. Labrum (Fig. 1) narrow, rounded with a narrow anteromedial emargination; distal margin with two rows of setae, setae of the longer row feathered; dorsal surface with an arc of about 10 long setae and a submedial pair of setae on each side, few short setae in the proximal half. Hypopharynx as in figure 2, lingua trilobate with minute thin setae.

Right mandible (Fig. 3) with completely fused incisors; prostheca reduced to a simple filament; setae between prostheca and mola reduced to a tuft; tuft of small setae near the mola; tuft of setae at the apex of the mola reduced to 2 or 3 setae; basal half with a stout seta perpendicular to the margin and few smaller setae dorsally.

Left mandible (Fig. 4) with completely fused incisors; prostheca reduced to a bifid filament; setae between prostheca and mola reduced to a tuft; tuft of feathered setae near the mola well-developed; tuft of setae at the apex of the mola reduced to 2 or 3 setae; basal half with a stout seta perpendicular to the margin and few setae dorsally.

Maxillae (Fig. 5) with the distal tooth opposed to the 3 others; 2 rows of setae, the first one formed by abundant small setae and the second by 3 long stout setae ending with 6 to 7 setae twice as long as the others, without pectinate or spine-like setae in the middle of the range; 4 setae at the base of the galea roughly arranged in a row; 1 single small seta perpendicular to the margin of the galea.

Labium (Fig. 6) with glossae and paraglossae equal in length; apical half of the inner margin of glossae with stout setae, very few small setae on the basal half of the ventral side, first segment of the labial palp 0.8 x length of second and third

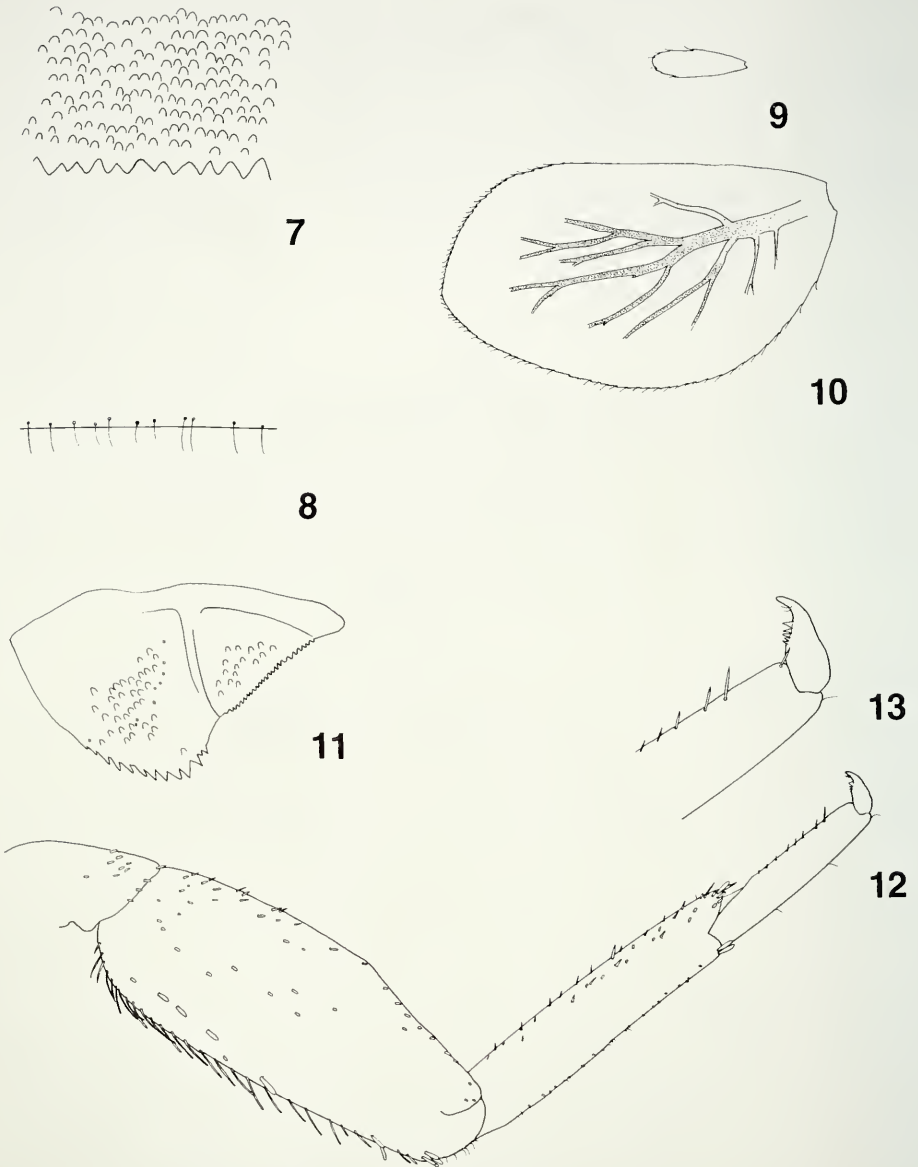


FIGS 1-6

Larval structures of *Xyrodromeus modestus*: 1: labrum (left: ventral; right: dorsal) 2: hypopharynx. 3: right mandible. 4: left mandible. 5: right maxilla. 6: labium.

combined; second segment weakly enlarged apically, row of 4 small setae; third segment slightly more narrow than apex of the second, with stout pointed setae apically.

*Thorax.* Coloration light brown. Hindwing pads present. Legs light brown, except the apex of femora and tarsi darker. Forelegs (Fig. 12). Coxae with small stout



FIGS 7-13

Larval structures of *Xyrodromeus modestus*: 7: posterior margin of the fourth tergum. 8: posterior margin of the fourth sternum. 9: first gill. 10: fourth gill. 11: paraproct. 12: foreleg. 13: tarsal claw.

setae. Femora dorsally with a row of long setae; submarginal row of 6 blunt setae; dorso-apical patch of 4 spatulate setae; short, pointed setae on the ventral margin. Tibiae dorsally with minute blunt setae, apex with two long setae; ventral margin with

small pointed setae; tibio-patellar suture absent. Tarsi with few dorsal setae; tarsal claws (Fig. 13) with a single row of 5 teeth increasing in length, subapical pair of setae present. Second and third legs similar to foreleg, except tibio-patellar suture present.

**Abdomen.** Uniformly light brown, except terga 5 to 8 with a brown slender, posterior U-shaped pattern. Terga (Fig. 7) with scales bases and without setae; posterior margin with broad, blunt spination. Sterna (Fig. 8) 1-6 pale yellow, without scale bases; smooth posterior margin without spines and with thin setae along the margin; sterna 7-9 brown, with pointed spines. Asymmetrical gills on abdominal segments 1 to 7; gill 1 (Fig. 9) oval, greatly reduced, without tracheation; gills 2-7 (Fig. 10) with dark tracheation, serrated with thin setae apically and posteriorly. Paraproct (Fig. 11) with about 12 pointed marginal spines; surface with about 35 scale bases; posterolateral extension with about 15 scale bases and with about 25 small spines along the margin.

ADULTS: unknown.

#### ETYMOLOGY

The specific epithet is Latin expressing the low degree of development of the mouthparts, especially of the labial palp and the labrum.

#### *Xyrodromeus latipalpus* sp. n.

Figs 14-26

#### MATERIAL

Holotype: 1 larva (P1008), Madagascar, Lokoho bas., Manantenina riv., Loc. Marojejy Camp1, Long. 49°46'48" E, Lat. 14°24'43" S, Alt. 425 m, 25.11.1999. Doumenq E.

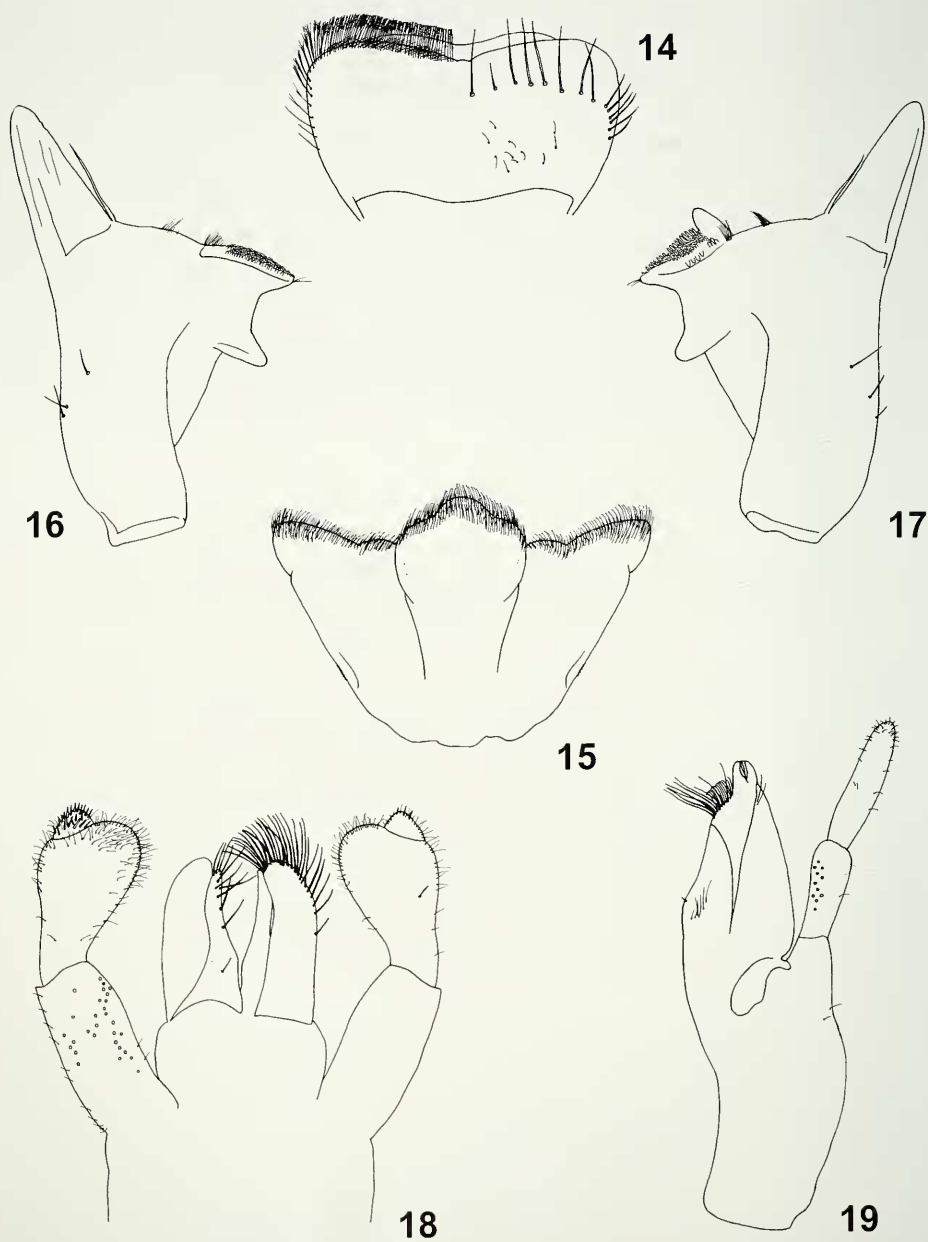
Paratypes: 1 female larva 1008a (on slide), 1 male larva 1008b (on slide) and 17 larvae (P1008), same data as holotype. 1 female larva 458a (on slide) and 2 larvae (P0458), Madagascar, Bas. Matitanana, Riv. Maintimbahatra, Loc. Village Faliarivo, Long. 47°19'28" E, Lat. 22°06'10" S, altitude 500 m, 21.6.1995. Andriamihaja M.R. and Ralaiteferana A. 3 larvae (P0874), Madagascar, Betaolana bas., Ambolokopatrika riv., Loc. Betaolana Camp 1, Long. 49°26'47" E, Lat. 14°32'25" S, Alt. 800 m, 09.10.1999. Doumenq E. 1 larva (P1023), Madagascar, Lokoho bas., Marolakana riv., Loc. Anjanaharibe-Sud Camp 1, Long. 49°30'84" E, Lat. 14°45'43" S, Alt. 800 m, 10.12.1999. Doumenq E.

#### LARVA

**Maximum length:** Body 5.1 mm. Cerci 3.2 mm and terminal filament 2.3 mm.

**Head.** Coloration almost uniformly light brown. Antennae pale yellow, except scape and pedicel light brown. Turbinate eyes light brown. Labrum (Fig. 14) trapezoid, broader apically; distal margin with two rows of setae, setae of the longer row feathered; dorsal surface with an arc of about 6+6 long setae on each side, submedial pair of setae, few short setae in the proximal half; each ventral, lateral surface with row of 3 minute setae. Hypopharynx as in figure 15, lingua trilobate with minute thin setae.

Right mandible (Fig. 16) with completely fused incisors; prostheca reduced to a simple filament; setae between prostheca and mola reduced to a tuft; tuft of small setae near the mola; tuft of setae at the apex of the mola reduced to 2 or 3 setae; basal half with 3 long and stout setae dorsally.



FIGS 14-19

Larval structures of *Xyrodromeus latipalpus*: 14: labrum (left: ventral; right: dorsal) 15: hypopharynx. 16: right mandible. 17: left mandible. 18: labium. 19: left maxilla.



Left mandible (Fig. 17) with completely fused incisors; prostheca reduced to a simple filament, without apical teeth; setae between prostheca and mola reduced to a tuft; tuft of feathered setae near the mola well-developed; tuft of setae at the apex of the mola reduced to 2 or 3 setae; basal half with 3 long and stout setae dorsally.

Maxillae (Fig. 19) with distal tooth opposed to the 3 others; 2 rows of setae, the first one formed by abundant small setae and the second by 2 long stout setae ending with 6 to 7 setae at least twice as long as the others, without pectinate or spine-like setae in the middle of the range; 6 setae at the base of the galea roughly arranged in a row; 1 single small seta perpendicular to the margin of the galea.

Labium (Fig. 18) with glossae and paraglossae subequal in length; apical half of the inner margin of glossae with long, stout setae; a single seta on the basal half of the ventral side; first segment of the labial palp 1.1 x length of the second and third combined; second segment with broadly rounded distomedial expansion, covered with numerous thin setae, ventral row reduced to a single seta; third segment asymmetrical, apically with stout pointed setae and thin ones.

*Thorax.* Coloration light brown. Hindwing pads present. Legs yellow except the apex and ventral margin of femora darker. Forelegs (Fig. 25). Coxae with minute stout setae. Femora dorsally with a row of numerous setae; submarginal row of setae absent; dorso-apical patch of 4 spatulated setae; minute, blunt or pointed setae on the ventral margin. Tibiae dorsally with a row of minute blunt setae and some thin short setae, apex with a single long seta; ventral margin with small pointed setae; tibio-patellar suture absent. Tarsi without setae dorsally; tarsal claws (Fig. 26) with a single row of 5 teeth increasing in length toward the apex, subapical pair of setae present. Second and third legs similar to foreleg, except tibio-patellar suture present.

*Abdomen.* Coloration of terga: 1-3 dark brown; 4-5 yellow; 6-7 dark brown; 8-9 yellow; 10 dark brown. Terga (Fig. 20) with scale and setal bases; posterior margin with broad, blunt spines. Sterna (Fig. 21) 1-7 yellow, without scale bases except laterally, smooth posterior margin without spines and with long thin setae irregularly arranged. Sterna 8-9 with pointed spines. Asymmetrical gills on abdominal segments 1 to 7; gill 1 (Fig. 22) reduced, without tracheation; gills 2-7 (Fig. 23) with dark tracheation, serrated with thin setae apically and posteriorly. Paraproct (Fig. 24) with about 17 pointed marginal spines; surface with about 25 scale bases, only in distal half; posterolateral extension with about 20 scale bases and with about 20 small spines along the margin.

ADULT: unknown.

#### ETYMOLOGY

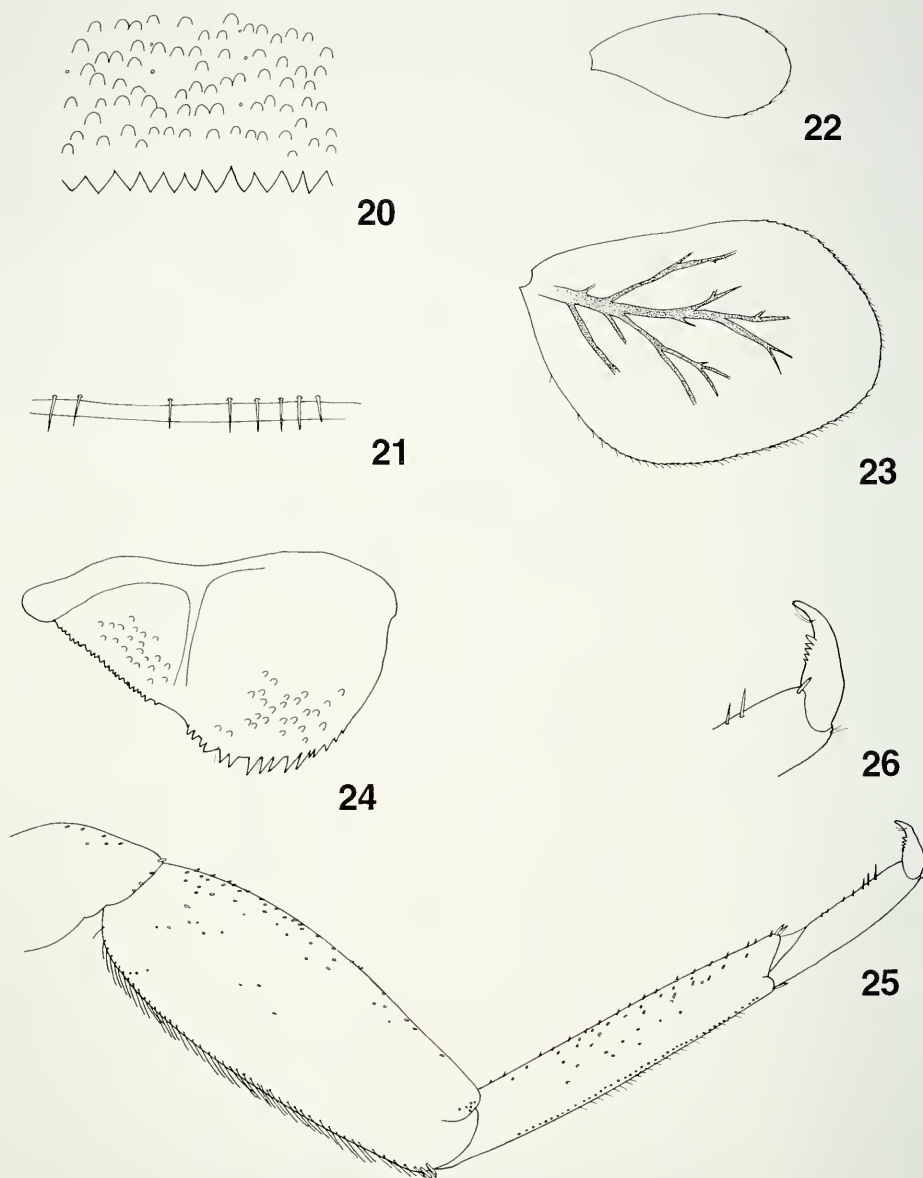
The specific epithet is Latin expressing the broad projection of the second segment of the labial palp.

*Xyrodromeus sartorii* sp. n.

Figs 27-37

#### MATERIAL

Holotype: 1 larva (P0861), Madagascar, Rianila bas., trib. of Sahatandra Riv., Loc. near Ambalafotsy, road to Lakato, Long. 48°21'48" E, Lat. 19°02'40" S, Alt. 1050 m, 08.04.1999. Gattolliat, J.-L. and Raberiaka, N.



FIGS 20-26

Larval structures of *Xyrodromeus latipalpus*: 20: posterior margin of the fourth tergum. 21: posterior margin of the fourth sternum. 22: first gill. 23: fourth gill. 24: paraprost. 25: foreleg. 26: tarsal claw.



Paratypes: 2 female larvae 861c and 861d (on slides), and 147 larvae (P0861), same data as holotype. 4 larvae (P0514), same locality as holotype, 19.10.1995. Elouard, J.-M. and Pilaka, T. 3 larvae (P0693), same locality as holotype, 22.04.1997. Gattolliat, J.-L. and Raberiaka, N. 3 larvae (P0507), Madagascar, Rianila bas., trib. of Sahatandra Riv., Loc. near Ambalafotsy, road to Lakato, Long. 48°21'50" E, Lat. 19°03'30" S, Alt. 1075 m, 19.10.1995. Elouard, J.-M., Pilaka, T., Randriamasimanana, D. and Andriambelo, Z.P. 1 larva (P0723), same locality as P0507, 29.04.1998. Elouard, J.-M., Sartori, M., Raberiaka, N. and Oliarinony, R. 1 male larva 862b (on slide), 1 female larva 862c (on slide) and 8 larvae (P0862), Madagascar, Rianila bas., trib. of Sahatandra riv., Long. 48°21'51" E, Lat. 19°02'22" S, Alt. 1050 m, 08.04.1999. Gattolliat, J.-L. and Raberiaka, N. 2 larvae (P0722), Madagascar, Rianila bas., trib. of Sahatandra Riv., Loc. near Ambalafotsy, road to Lakato, Long. 48°21'38" E, Lat. 19°03'07" S, Alt. 1050 m, 29.04.1998. Elouard, J.-M., Sartori, M., Raberiaka, N., Oliarinony, R. 1 larva (P0760), same locality as P0723, 15.10.1998. Legrand, J. and Raberiaka, N.

Other material: 11 larvae (P0269), Madagascar, Mangoro bas., trib. of Ankeniheny riv., Loc. Réserve Manjakatampo Ankaratra, Long. 47°18'46" E, Lat. 19°21'23" S, Alt. 1700 m, 06.03.1995. Elouard, J.-M., Pilaka, T. and Blanc, L. 27 larvae (P0282), Madagascar, Mangoro bas., trib. of Ankeniheny riv., Loc. Réserve Manjakatampo Ankaratra, Long. 47°17'50" E, Lat. 19°21'48" S, Alt. 1750 m, 10.03.1995. Pilaka, T. and Blanc, L. 1 larva (P0292), Madagascar, Sakanila bas., Lakato riv., Loc. road to Lakato, Long. 48°25'08" E, Lat. 19°08'33" S, Alt. 690 m, 20.03.1995. Blanc, L. 2 larvae (P0341), Madagascar, Mandrare bas., Marotoko riv., Loc. 2 km after Mananara, Long. 46°38'50" E, Lat. 24°44'02" S, Alt. 275 m, 03.06.1994. ORSTOM, Antananarivo. 1 larva (P0510), Madagascar, Mangoro bas., Manambolo riv., Loc. Mandraka, Long. 47°55'58" E, Lat. 18°55'17" S, Alt. 1050 m, 18.10.1995. Pilaka, T. 2 larvae (P0543), Madagascar, Manampanihy bas., Andranohela riv., Loc. Camp II Andohahela, Long. 46°44'25" E, Lat. 24°35'47" S, Alt. 850 m, 26.11.1995. Elouard, J.-M. and Pilaka, T. 8 larvae (P0586), Madagascar, Mangoro bas., Ankeniheny riv., Loc. Temespoony, Long. 47°20'30" E, Lat. 19°22'27" S, Alt. 1580 m, 14.04.1996. Elouard, J.-M., Randriamasimanana, D. and Oliarinony, R. 17 larvae (P0587), Madagascar, Mangoro bas., Tsaratanana riv., Loc. Ankirihitra, Long. 47°17'37" E, Lat. 19°23'00" S, Alt. 1700 m, 14.04.1996. Elouard, J.-M., Randriamasimanana, D. and Oliarinony, R. 2 larvae (P0600), Madagascar, Mangoky bas., Manambaroa riv., Loc. 24 km from Amborompotsy, Long. 46°23'55" E, Lat. 20°37'10" S, Alt. 1100 m, 24.05.1996. Elouard, J.-M. 3 larvae (P0621), Madagascar, Lokoho bas., unnamed riv., Loc. Marojejy Camp II, Long. 49°45'33" E, Lat. 14°26'05" S, Alt. 750 m, 15.10.1996. Legrand, J. and Randriamasimanana, D. 2 larvae (P0623), Madagascar, Lokoho bas., Manantenina riv., Loc. Marojejy Camp II, Long. 49°45'37" E, Lat. 14°25'57" S, Alt. 720 m, 17.10.1996. Legrand, J. and Randriamasimanana, D. 2 larvae (P0628), Madagascar, Lokoho bas., trib. of Manantenina riv., Loc. Marojejy Camp II, Long. 49°45'57" E, Lat. 14°25'57" S, Alt. 730 m, 20.10.1996. Legrand, J. and Randriamasimanana, D. 2 larvae (P0728), Madagascar, Mangoro bas., trib. of Ankeniheny riv., Loc. Manjakatampo Ankaratra, Long. 47°18'46" E, Lat. 19°21'23" S, Alt. 1700 m, 30.04.1998. Elouard, J.-M. and Sartori, M. 3 larvae (P0741), Madagascar, Sakanila bas., Lakato riv., Loc. road to Lakato, Long. 48°24'51" E, Lat. 19°08'20" S, Alt. 720 m, 18.02.1999. Elouard, J.-M. and Raberiaka, N. 1 larva (P0818), Madagascar, Antongombato bas., Makis riv., Loc. Camp WWF, Long. 49°10'09" E, Lat. 12°31'40" S, Alt. 1080 m, 23.03.1999. Gattolliat, J.-L. and Rabeantoandro, Z. 27 larvae (P0872), Madagascar, Betaolana bas., Ambolokopatrika riv., Loc. Betaolana Camp I, Long. 49°26'47" E, Lat. 14°32'25" S, Alt. 800 m, 08.10.1999. Doumenq E. 2 larvae (P0874), same locality as P0872, 09.10.1999. Doumenq E. 1 larva (P0877), same locality as P0872, 10.10.1999. Doumenq E. 35 larvae (P0893), Madagascar, Ampary bas., Anlanbe riv., Loc. Anjanaharibe S-W Camp1, Long. 49°26'53" E, Lat. 14°47'00" S, Alt. 1200 m, 26.10.1999. Doumenq E. 45 larvae (P0897), same locality as P0893, 27.10.1999. Doumenq E. 21 larvae (P0898), same locality as P0893, 30.10.1999. Doumenq E. 5 larvae (P0899), same locality as P0893, 31.10.1999. Doumenq E. 1 female larva 1009b and 31 larvae (P1009), Madagascar, Lokoho bas., Manantenina riv., Loc. Marojejy Camp2, Long. 49°45'58" E, Lat. 14°26'23" S, Alt. 800 m, 26.11.1999. Doumenq E. 10 larvae (P1020), Madagascar, Lokoho bas., Ambatomainty riv., Loc. Anjanaharibe-Sud Camp 2, Long. 49°27'70" E, Lat. 14°44'70" S, Alt. 1260 m,

07.12.1999. Doumenq E. 75 larvae (P1021), Madagascar, Lokoho bas., Marolakana riv., Loc. Anjanaharibe-Sud Camp 3, Long. 49°26'50" E, Lat. 14°44'50" S, Alt. 1550 m, 08.12.1999. Doumenq E.

#### LARVA

*Maximum length:* Body 7.1 mm. Cerci 5.6 mm and terminal filament 2.6 mm.

*Head.* Dark brown with broad yellow patterns between eyes and lateral ocelli, and between central ocellus and labrum, vermiform marks on vertex and frons poorly visible. Antennae pale cream yellow, except scape brown. Turbinate eyes purple-brown. Labrum (Fig. 27) subrectangular; distal margin with two row of setae, the longer row feathered; dorsal surface with an arc of about 20 long setae on each side, submedial pair of setae, few short setae in the proximal half; without setae ventrally. Hypopharynx as in figure 28, lingua not trilobate with minute thin setae.

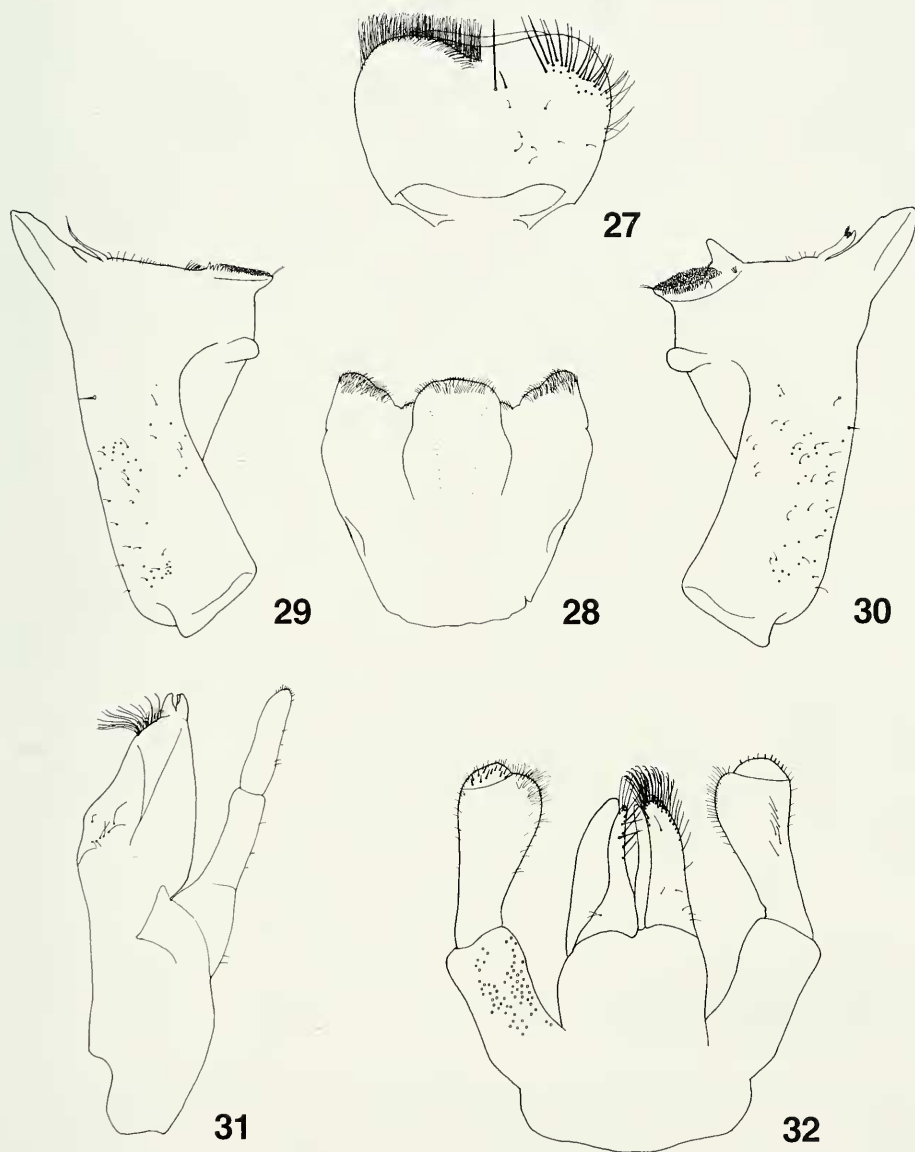
Right mandible (Fig. 29) with two sets of fused incisors, the inner one extremely reduced; prostheca reduced to a simple filament; a complete row of short setae between prostheca and mola; tuft of small setae near the mola; tuft of setae at the apex of the mola reduced to 2 setae; basal half with a stout seta perpendicular to the margin and abundant smaller setae dorsally.

Left mandible (Fig. 30) with completely fused incisors; prostheca with denticles and a comb-shape structure apically; scarce short setae between prostheca and mola; tuft of setae under the mola; tuft of setae at the apex of the mola reduced to 2 or 3 setae; basal half with a stout seta perpendicular to the margin and abundant small setae dorsally.

Maxillae (Fig. 31) with distal tooth opposed to the 3 others; 2 rows of setae, the first one formed by abundant small setae and the second by 4 long stout setae ending with 8 setae twice as long as the others, without pectinate or spine-like setae in the middle of the range; 6 setae at the base of the galea roughly arranged in a row; 1 single small seta perpendicular to the margin of the galea.

Labium (Fig. 32) with glossae and paraglossae subequal in length; apical half of the inner margin of glossae with stout setae, two small setae on the basal half; first segment of the labial palp 0.9 x length of the second and third combined; second segment with a rounded distomedial expansion, covered with numerous thin setae, row of 6 thin setae; third segment broad cap-like, with stout pointed setae apically.

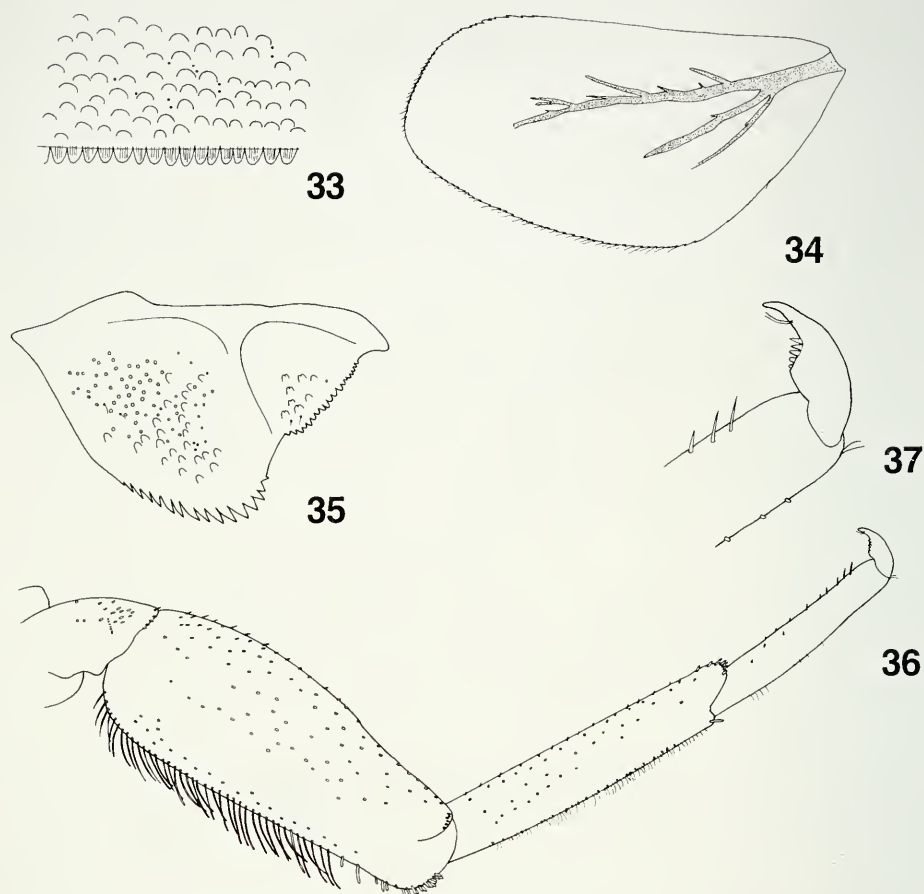
*Thorax.* Uniformly brown. Hindwing pad present. Legs coloration: femora brown with pale cream stripe subparallel to the dorsal margin; tibiae pale cream with inner margin darker; tarsi pale cream apically brown. Forelegs (Fig. 36). Coxae with small blunt setae. Femora dorsally with a row of long setae, scarce and short subapically; submarginal row of numerous minute setae; dorsoapical patch of several small broad setae; numerous, minute setae on the ventral and lateral margins. Tibiae dorsally with a row of minute blunt setae and some thin setae; apex dorsally with 1 long seta; ventral margin with minute pointed setae; tibio-patellar suture absent. Tarsi dorsally with few setae; tarsal claws (Fig. 37) with a single row of 5 teeth increasing in length, subapical pair of setae present. Second and third legs similar to foreleg, except tibio-patellar suture present.



FIGS 27-32

Larval structures of *Xyrodromeus sartorii*: 27: labrum (left: ventral; right: dorsal) 28: hypopharynx. 29: right mandible. 30: left mandible. 31: left maxilla. 32: labium.

*Abdomen.* Coloration of the terga: 1-3 brown; 4-5 yellow except margin brown; 6 brown; 7-8 brown with two yellow patterns; 9-10 brown. Terga (Fig. 33) with scale bases and few setae; posterior margin with broad, blunt spines. Sterna light



FIGS 33-37

Larval structures of *Xyrodromeus sartorii*: 33: posterior margin of the fourth tergum. 34: fourth gill. 35: paraproct. 36: left foreleg. 37: tarsal claw.

brown, except 7-9 brown; sterna 1-6 with smooth posterior margin with a continuous row of setae without spines; sterna 7-9 with pointed spines. Asymmetrical gills (Fig. 34) on abdominal segments 2 to 7; dark tracheation poorly developed, serrated, with thin setae apically and posteriorly. Paraproct (Fig. 35) with about 15 pointed marginal spines; surface with about 25 scale bases and numerous setae insertions; posterolateral extension with about 8 scale bases and with about 18 small spines along the margin.

ADULTS: unknown.

#### ETYMOLOGY

This species is dedicated to the distinguished Ephemeropterologist M. Sartori.



*Xyrodromeus namarona* Lugo-Ortiz & McCafferty

Figs 38-40

## MATERIAL EXAMINED

1 male imago with corresponding larval skin 191a (on slide), Madagascar, Antongombato bas., Makis riv., Loc. Camp WWF, Long. 49°10'09" E, Lat. 12°31'40" S, Alt. 1075 m, 28.03.1994. Elouard, J.-M. and Sartori M. 1 male imago with corresponding larval skin 194a (on slide), same locality as 191a, 29.03.1994. Elouard, J.-M. and Sartori M. 1 male larva 200a (on slide) and 2 larvae (P0200), same locality as 191a, 02.04.1994. Elouard, J.-M. and Sartori M. 1 male larva 818g (on slide) and 6 larvae (P0818), same locality as 191a, 23.03.1999. Gattolliat, J.-L. and Rabeantoandro, Z. 1 female larva 826d (on slide) and 10 larvae (P0826), same locality as 191a, 25.03.1999. Gattolliat, J.-L. and Rabeantoandro, Z. 1 male larva 509-12 (on slide) and 2 larvae (P0509), Madagascar, Mangoro bas., Manambolo riv., Loc. Mandraka, Long. 47°56'10" E, Lat. 18°55'23" S, Alt. 1025 m, 18.10.1995. Randriamasimanana, D. and Andriambelo, Z.P. 1 male larva 158a (on slide), Madagascar, Mangoro bas., unnamed riv., Loc. Station forestière Mandraka, Long. 47°55'27" E, Lat. 18°54'49" S, Alt. 1200 m, 20.10.1995. Randriamasimanana, D. 1 male larva 641c (on slide) and 18 larvae (P0641), Madagascar, Namorona bas., Namorona riv., Loc. Ranomafana, Long. 47°27'18" E, Lat. 21°15'37" S, Alt. 725 m, 05.11.1996. Gibon, F.-M., Legrand, J., Gattolliat, J.-L., Rochat, C. and Randriamasimanana, D. 1 male larva 642-2 (on slide), Madagascar, Namorona bas., unnamed riv., Loc. Hotel Domaine nature, Long. 47°26'36" E, Lat. 21°15'07" S, Alt. 780 m, 06.11.1996. Legrand, J., Gattolliat, J.-L. and Randriamasimanana, D. 1 male larva 643a (on slide) and 5 larvae (P0643), Madagascar, Namorona bas., Ambatoaranana riv., Loc. Ranomafana village, Long. 47°27'26" E, Lat. 21°15'23" S, Alt. 770 m, 08.11.1996. Gattolliat, J.-L., Rochat, C. and Randriamasimanana, D. 1 female larva 822b, 1 male larva 822c (on slides) and 6 larvae (P0822), Madagascar, Antongombato bas., Makis riv., Loc. 100m from the Great Cascade, Long. 49°10'14" E, Lat. 12°29'17" S, Alt. 675 m, 24.03.1999. Gattolliat, J.-L. and Rabeantoandro, Z. 1 male larva 861e (on slide) and 79 larvae (P0861), Madagascar, Rianila bas., trib. of Sahatandra Riv., Loc. near Ambalafotsy, road to Lakato, Long. 48°21'48" E, Lat. 19°02'40" S, Alt. 1050 m, 08.04.1999. Gattolliat, J.-L. and Raberiaka, N. 23 larvae (P0862), Madagascar, Rianila bas., trib. of Sahatandra riv., Long. 48°21'51" E, Lat. 19°02'22" S, Alt. 1050 m, 08.04.1999. Gattolliat, J.-L. and Raberiaka, N. 1 male larva 870a, 1 female larva 870b (on slides) and 118 larvae (P0870), Madagascar, Tsiribihina bas., Sahatsio riv. (trib. of Mania riv.), Loc. Antsirabe, Long. 47°02'57" E, Lat. 19°49'55" S, Alt. 1500 m, 15.04.1999. Gattolliat, J.-L. and Doumenq, E.

LARVA: see Lugo-Ortiz & McCafferty, 1997.

## MALE IMAGO

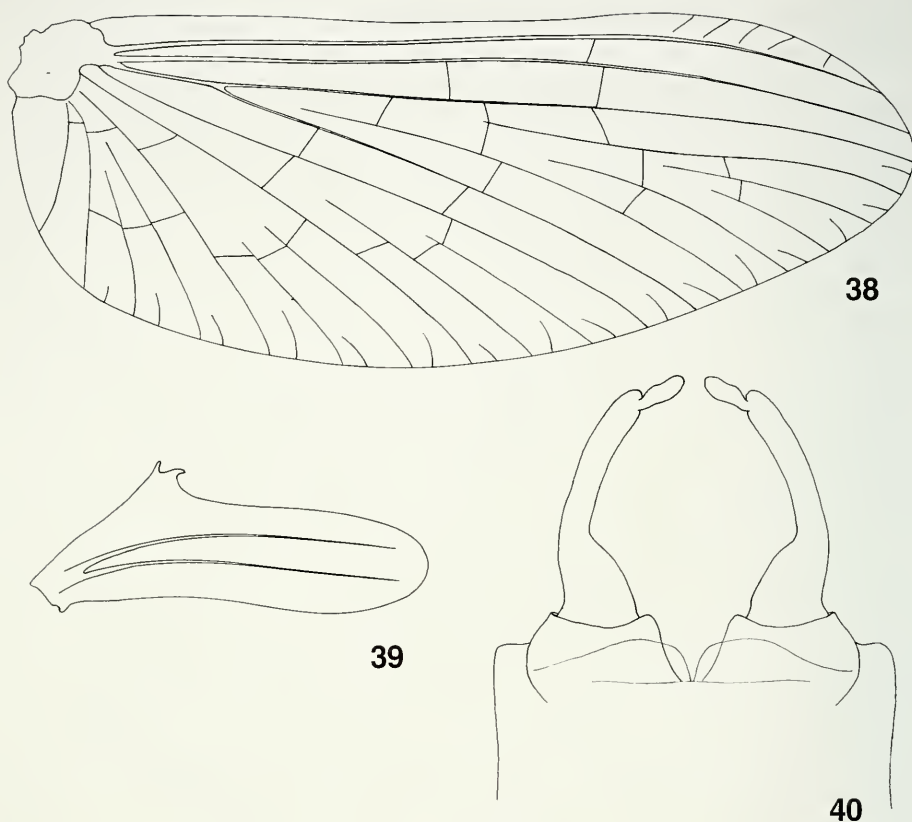
*Maximum length:* Body 6 mm. Cerci broken. Forewing 5.7 mm. Hindwing 0.8 mm.

*Head.* Light brown without marking. Turbinate eyes yellowish brown.

*Thorax.* Coppery brown. Forewing (Fig. 38) hyaline, with one relatively long intercalary vein between longitudinal veins except between subcostal and first radial veins; pterostigma with 5 to 8 vertical cross-veins that generally do not reach the subcostal vein. Hindwing (Fig. 39) hyaline with 2 distinct longitudinal veins, joined at the base; 2 distinct spurs on the costal margin.

*Abdomen.* Terga light brown with a proximal dark brown stripe proximally; sterna light brown.

*Genitalia* (Fig. 40) with 3-segmented gonopods, the limit between the first and the second barely visible. First segment stout, without setae; second segment with subparallel margins in apical 2/3; third segment elongate, outer margin incurved.



FIGS 38-40

Male imaginal structures of *Xyrodromeus namarona*: 38: forewing, 39: hindwing, 40: genitalia.

## DISCUSSION

The three new species described herein clearly belong to the genus *Xyrodromeus*. They all possess the main characters of this genus such as: mandibles with bladeliike incisors, second segment of the labial palp distomedially expanded, third segment of the labial palp short and nipple-like, villopore absent, tibiae and tarsi without an important row of setae and tarsal claws with a single row of teeth.

*Xyrodromeus namarona*, *X. modestus* and *X. latipalpus* constitute a very homogenous lineage. Important features such as the mandibles are almost identical among the three species (Figs 3, 4, 16, 17). The shape of the second segment of the labial palp and the width of the labrum show an interesting coevolution. *X. modestus* possesses a narrow labrum (Fig. 1) and a second segment of the labial palp weakly expanded distomedially (Fig. 6). At the opposite extreme, the labrum of *X. latipalpus* is very broad (Fig. 14) and the second segment of the labial palp is also broadly expanded (Fig. 18). *X. namarona* possesses intermediate features between the two species.



*Xyrodromeus sartorii* differs from the other species of the genus in that gills are absent from abdominal segment 1; the incisors of left mandible are fused in two sets instead of one (Fig. 29), the right prostheca is not slender (Fig. 30) and few setae are present on the dorsoapical margin of the femora (Fig. 36).

The description of these three new species of *Xyrodromeus* and especially the knowledge of the imaginal stage of *X. namarona* allow to complete the description of the genus and to clarify its relationships with other complexes of genera. The imagoes of *Xyrodromeus* can be diagnosed as follow: forewings with single intercalary between longitudinal veins; hindwing with 2 longitudinal veins and 2 distinct spurs on the costal margin, male genitalia 3-segmented without modification of second segment of gonopods and with the third segment elongated.

*Xyrodromeus* cannot belong to the *Bugilliesia* complex because it lacks a basomedial protuberance on the second segment of the male gonopods (Lugo-Ortiz & McCafferty, 1996). The forewings, the two distinct spurs on the costal margin of the hindwing and the shape of the gonopods of *Xyrodromeus* are identical with those of *Afroptilum* Gillies, *Herbrossus* McCafferty & Lugo-Ortiz and *Platycloeon* Gillies & Wuillot (Gillies, 1990; Gillies & Wuillot, 1997; Gattolliat & Sartori, 1998; Gattolliat *et al.*, 1999). All these genera belong to the Afrotropical *Centroptiloides* complex (Lugo-Ortiz & McCafferty, 1998a). If the imagoes of *Xyrodromeus* can be separated from the *Herbrossus* ones by the number of longitudinal veins of the hindwings, no reliable character distinguishes *Xyrodromeus* from species of *Afroptilum* and *Afroptiloides* in the imaginal stage (Gillies, 1990; Gattolliat *et al.*, 1999).

In the larvae, *Xyrodromeus* possesses a single row of teeth on the tarsal claws (Figs 13, 26, 37) instead of the double row found in other genera of the *Centroptiloides* complex (Lugo-Ortiz & McCafferty, 1998a). However, the reduction of the second row of teeth can be observed in other lineages of Baetidae, such as the genus *Afrobaetodes* (Gillies, 1991a; Gattolliat & Sartori, 1999a) and *Afroptiloides* (Gillies, 1991b; Gattolliat, 2000). This suggests that *Xyrodromeus* is more derived than other genera of the *Centroptiloides* complex. This hypothesis is confirmed by the high degree of specialization of the mouthparts for scraping.

#### KEY TO THE MALAGASY LARVAE OF *XYRODROMEUS*

- 1 Abdominal segment 1 without gills; dorsal margin of femora with a row of setae interrupted a quarter before the apex (Fig. 36)  
..... *Xyrodromeus sartorii* sp. n.
- Abdominal segment 1 with gills, although often very small (Fig. 1); dorsal margin of femora with an uninterrupted row of setae (Figs 12-25) . . . 2
2. Labrum narrow (Fig. 1); second segment of the labial palp weakly expanded distomedially (Fig. 6) . . . . . *X. modestus* sp. n.
- Labrum broad (Fig. 14); second segment of the labial palp expanded distomedially (Fig. 18) . . . . . 3
- 3 Labrum trapezoid, broader distally (Fig. 14); second segment of the labial palp with broadly rounded distomedial expansion (Fig. 18); prostheca reduced to a simple filament (Figs 16-17); terga well-contrasted yellow and brown . . . . . *X. latipalpus* sp. n.

- Labrum subrectangular, as broad distally as proximally (Fig. 13, in Lugo-Ortiz & McCafferty, 1997); second segment of the labial palp with rounded distomedial expansion (Fig. 16, in Lugo-Ortiz & McCafferty, 1997); prostheca reduced to a bifid filament; terga generally uniformly light brown . . . . . *X. namarona* sp. n. Lugo-Ortiz & McCafferty

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